SECRET

OSA-6392-63
Copy 3 of 4

26 December 1963

Dear Jim,

Due to the circumstances outlined in your letter of 25 November 1963 (DOC.JDN-63.00053) and in order to meet the schedule requirements, we agree with your recommendation that the first sextants be delivered with the obsolete counters with the new counters to be delivered and installed by the field technical representative when they become available.

Yours very truly,

SIGNED

[redacted] 25X1A

25X1A CD/OSA/[redacted] bds

Dist: Cyl&2 - Baird-Atomic, Inc.
3 - CD/OSA - BA-1929
4 - RB/OSA

NAVY review(s) completed.

SECRET

OSA - 6046-63

John

DOC. JDN-63. 00053

25 November 1963

Attention: John G.

Reference: Contract No. BA-1929

STATINTL

Dear John,

Our vendor for counters- [redacted] is on strike at the present time. We do not know when they will return to work, however, they have changed their original delivery time from eleven to sixteen weeks and this delivery schedule will not commence until the termination of the strike. Due to this situation, which is beyond our control, we would like to request your permission to deliver the first ten or fifteen retro-fitted sextants to the field with obsolete type counters.

We will deliver the new counters for the units already delivered to the respective locations for field installation when they become available.

We shall appreciate any consideration you may give us for this waiver so that we would be able to meet our promised delivery schedule.

STATINTL

[redacted] has been informed by a telephone conversation of this same situation.

Sincerely,

[redacted]

STATINTL

STATINTL

dc

CC: [redacted]

BAIRD-ATOMIC, INC.

BA 1 of 9 proposal Dec.

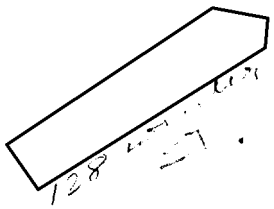
Periscopic Sextant Improvement Proposal

Baird-Atomic is pleased to submit this proposal for improving the accuracy, reliability and maintenance of the periscopic sextant type 5111C.

The present sextant has been in use for seven years and has only had overhaul work performed when a malfunction occurred, as a result there is very little conformity among the units. Some incorporate minor design change improvement and others do not. The proposed program will relieve this problem by standardizing all the units to the latest configuration, therefore, new type and serial numbers will be provided. We are also suggesting that a manual be supplied which will serve as an "Operation and Maintenance" manual as well as an "Illustrated Parts Breakdown".

The many design changes that have taken place and that we are suggesting will give an end product with the following;

STATINTL



1) 30 - 50% increase in instrument accuracy
2) increased reliability
3) decrease in maintenance problems
4) improve operator ability to observe and position celestial bodies.

These topics will be described in detail in the following pages.

The unit will be similar to the sextant used by the Navy in the A3D, T39D, and C2A Carrier Based Navy Plane, but will incorporate additional improvements, e.g., the improved bubble design. The Navy sextant has successively undergone and passed the required preproduction and sampling tests detailed in Mil Standard MIL-S-21639.

General

In order the the sextant to be efficiently used for accurate flight navigation we feel that four major problem areas should be investigated: (1) the sextant, (2) the sextant maintenance program, (3) the sextant training program, and (4) errors due to airplane motion.

The improvements which can be made to the sextant without major design work and thus the expenditure of many dollars are explained in the next section.

The sextant maintenance program will be made easier by having a standard unit and the appropriate manuals to enable the airforce technicians to do a fast accurate repair job when needed. In the past their task has been complicated many times by this lack of conformity. It is a tribute to them that they have been able to do as well as they have. With the appropriate guidance from the manuals and the roving technical representative we have in the field, we feel the maintenance problems will be minimized.

The sextant training program is the responsibility of the operations group with whatever aid and assistance Baird's roving representative can give. We feel that even if each operator does have a personal error when making celestial observations he will constantly shoot within 3 to 4 nautical miles when the airplane is flying reasonably straight a level, the celestial body is continually tracked in elevation during the averaging time used and the operator has gained confidence in his ability. The averaging time used must be an even multiple of the phugoid oscillations of the aircraft's motion in order to get an accurate reading of the celestial body's elevation.

The errors due to airplane motion called cross-level tilt errors are described in detail in Air Navigation, Vol. 2, page 339 and in an error analysis written by Baird-Atomic, Inc. in 1957. The analysis shows what the sextant is self-compensating for tilts in the level plane (toward or away from the star) and is only affected by cross level tilts. In practice the errors are reduced somewhat by refraining from the use of the Azimuth Control Knob as much as possible during a sight and endeavoring to keep the star moving up and down along the elevation line (the single arrow line) and making the elevation setting by placing the star as close to the bubble as possible in elevation, still keeping it on the elevation arrow.

These general comments can be expanded upon at length and are mention only to point out that while most of the problems can be reduced with the sextant change, it is worthwhile to note the areas that must be watched carefully for additional sources of error.

Sextant Improvements

This section will be broken into four sub-sections in order to present how each change will contribute to the performance of the unit. The sections are: (1) accuracy, (2) reliability, (3) maintenance and (4) operator presentation improvements.

(1) Instrument Accuracy

The changes that will contribute to an increase in the instrument's accuracy are as follows:

a) Elevation Gear Train -- Presently the elevation gear train uses brass gears which have worn and become sloppy. We will replace these gear assemblies with a more precise elevation gear train using stainless steel gears. This will decrease backlash and increase the instrument's ability to transmit accurate elevation information to the operator. This will be a 30% increase in instrument accuracy.

b) New Bearings -- Bearings with extremely high accuracy specification are now available and should be incorporated to maintain the accuracy improvements made with the gear changes.

c) Improve Bubble -- This bubble will be smaller and have its size controlled by a new bubble oven creating a uniform temperature around the entire bubble. This will eliminate any wander and size change that contributes to the error in the sextant. This will be a 10% increase in instrument accuracy.

d) Controls -- see attached sheet labelled "Averager Control" for details and suggested solutions.

e) New Upper and Lower Housings -- the present housing are seven years old and have been separated and aligned so many times that they are warped and almost impossible to align within the required tolerances. This will give an additional 10% to the instrument accuracy.

Total instrument accuracy improvement 50%, that is from 3 minutes of arc to 1 1/2 minutes of arc in elevation.

2. Reliability Improvements

The reliability improvements that will be realized are:

a) Bubble Shelf Levelling-- This method of levelling the bubble is more accurate and can be done on the bench. It can then be locked into position requiring only that it be centered in the unit when calibrating. The present method is subject by shock over a period of time.

b) Improve Bubble -- The bubble will be in a more efficient atmosphere than present thus making the power requirements less. The bubble will also include a Mil Spec thermostat which will have longer life and greater reliability than the present one. This is a new thermostat available in size that we can use. We will also install an arc suppression to the thermostat to filter out the [illegible] which contributes to the death of the thermostat.

c) New Elevation Counter -- This counter will have hardened steel gears instead of brass as is presently used. It will give superior performance and a much longer life than the present counter. The frequency at which counters have been purchased in the pass will indicate the need for this counter. We have made test and found that the rotational speed the counter can be turned at exceeds the specification of the present counter.

3. Maintenance Improvements

As mentioned at the beginning of this proposal most of the maintenance problems will be solved by having a standard unit. In addition the following items will help.

a) Bubble Shelf Levelling -- As mentioned in subsection (1), this will be done on the bench and will not be required again unless the the assembly is removed from the unit.

b) New Housings -- If separation of the upper and lower housing is required new housing will permit easier and faster alignment, and will be sealed by an "O" to assure a sealed unit. This will make the need to clean the unit due to condensation about 25% the number of times now required.

c) Counter -- Minimize the need to replace the counter due to wear.

d) Bubble Lighting -- This will be a modular assembly which can be replaced in the aircraft.

e) New Bubble -- By having essentially a new bubble the problem of readjusting for size and thermostat replacement will be minimized.

f) Averager Problem -- see attached sheet labelled "Averager Control"

4. Operator Presentation Improvements

In this subsection the increases in accuracy realized by an improved presentation are difficult to put into actual figures. This is primarily due to the difference in the dirvers using the unit. Some drivers will be affected more by certain changes than other drivers. The changes we are suggesting are positive and should

permit more accurate celestial observation by all the drivers using the instrument.

The changes proposed are as follows:

a) Installation of a Pellicle -- The pellicle will replace the beam splitter which images the bubble into the optical path. The present beam splitter is half silvered mirror which has a back surface creating a ghost image. The second image is aggravating to the observer and can be the cause of fatigue thus being responsible for inaccurate observations. The pellicle will give a single sharp bubble image.

b) Smaller Bubble Size -- With a smaller bubble in 1^{o} or twice the sun diameter vs. 1^{o} 30' presently used the operator will be able to position the celestial body with greater accuracy in the bubble. Even though the eye is extremely accurate when centering an object this will probably contribute to increased accuracy by making it easier for the driver to center the body and to keep it in the center throughout the observation time.

c) Bubble Lighting -- By using the new bubble we are able to incorporate a new lighting design. We use a lucite pipe which illuminates the bubble all around evenly as opposed to the sectional lighting now used. By having a sharp well illuminated bubble image the operator will be able to make accurate observation under any conditions.

d) Increase Transmission -- The accuracy with which an observer can track a star depends markedly on such factors as brightness of the star image, its clarity, etc. Therefore, all optical elements should have new efficient coatings which will increase the transmission and image quality through the system. This will again increase the accuracy by removing an element of fatigue.

Sky Compass Addition

Baird-Atomic would like to propose the addition of a sky compass be incorporated in the sextant to give added heading coverage during those periods when celestial bodies are not available for observation, e. g, twilight periods in Northemlatitudes. This compass works on the same principle as the pfund sky compass -- It utilizes the principle that the Zenith sky becomes polarized in a plane perpendicular to the direction of the sun. This is due to atmospheric scattering.

6. Averager Controls

Attached to this sub section is Appendix I which details the error possibly due to twist and backlsh in the cables. The resultant error is 9. 17 nautical miles. This is slightly misleading in so far as this error is averaged out during the time of the observation by the constant ccw and cw rotation of the cables, but nevertheless there is a substantial error involved.

To reduce this angular deflection error of the flexible shafts a heaver diameter shaft is requir d. This shaft would be a low friction teflon line casing, low backlash F adapter (at the averager and low backlash splined fittings, and would result in the deflection being reduced to approximately 2 degrees vs. the present 11 degrees, that is from 9 nautical miles to about 2 nautical miles. The cable would be 2 times the diameter of the present cables.

If the larger flex shafts cannot be installed in the aircraft and if it is too difficult to rotate the shaft the averager will have to be placed next to the sextant and have the image of the averager indices piped optically into the sextant presentations. In addition provision will be made for winding up the averager on starting it when needed.

We suggest that the airframe manufacturer procure and install the larger flex cables while Baird does a complete check on the averager and associated gearing. Most of the gearing will have to be repaird and in general given a good overhaul. Therefore when the sextant is returned to us for these changes the averager should also accompany it.

If neither of the above approaches are acceptable, we are enclosing a proposal to servo mechanize the drive while maintaining the manual overide.

Next 2 Page(s) In Document Exempt

14 August 1963

Sextant Improvement -- Material Costs in Quantities of 50

1. Standardize R44 Model to the 5111e Model

Description	P/N	Unit Cost
Lower Housing	10403-94	88.00
Upper Housing	10403-67	70.00
Bubble Shelf Levelling	10634-463	32.09
Pawl & Plate Assy	N/A	7.03
Upper Jack Shaft	10634-330	17.87
Lower Jack Shaft	10634-333	41.34
Elev. Worm Assy	10634-339	59.33
Elev. Rack Assy (Rework Parts)	10634-337	70.00
Bulkhead Housing	10403-95	12.25
Baffle Field Lens	10605-22	2.80

2. Improve Reliability

New Counter	106.00 quote
New Thermostat	10.00 quote
Arc Suppressor	8.00 estimate

3. Accuracy Improvements

Improved Bubble	60.00
Pellicle Assy (Bubble image)	70.00
Bubble Lighting	15.00
New Bearings (Standard)	25.00
Recoat the optics where possible	50.00 ?
Controls (STANDARD)	30.00 ?

4. Averager Changes Due to Larger Cables

Gears	100.00
Shafts	10.00
Housing	30.00
Adapters	40.00
Total	954.71

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Adapters	40.00
Total	954.71

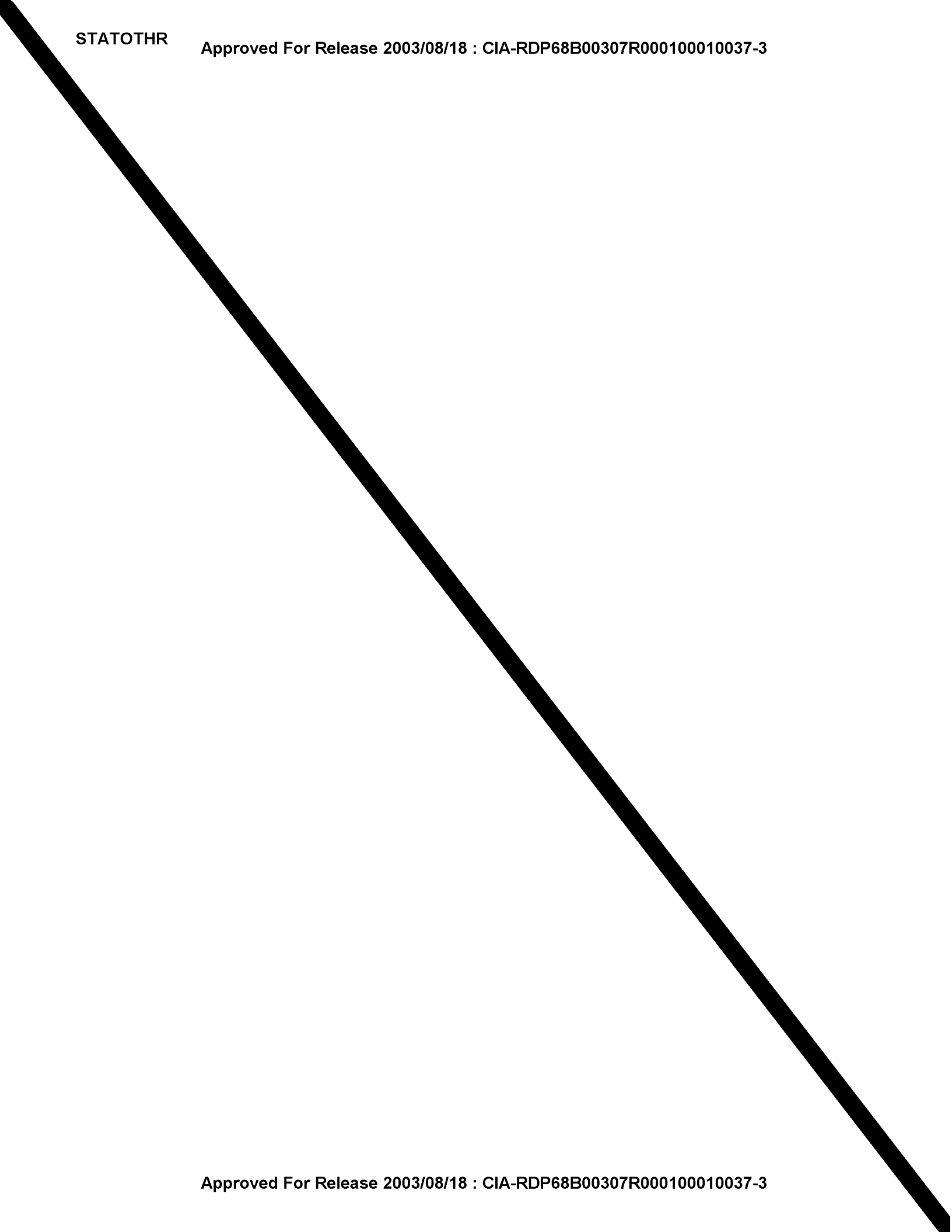
Next 1 Page(s) In Document Exempt

Cost and Delivery Estimate

This proposal is submitted on a firm fixed price basis. The following sheets will detail the cost estimate for this effort. We have separated the cost for the Sky compass & the averager servo drive for your convenience.

Baird-Atomic request a 3 month lead time to finish the design change and procure the material. We can then delivery the first group of 5 units by the 4th month A. R. O. and continue to do 5-10 units per month until completion. This schedule can be varied to meet the customer's requirements.

Approved For Release 2003/08/18 : CIA-RDP68B00307R000100010037-3



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